Mental Models
INTERVIEWING
for More-Effective Communication

A PRIMER

Joe Cone
Kirsten Winters
Oregon Sea Grant

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Public Science Communication
Research & Practice

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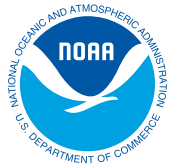

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Introduction

What are mental models?

As with other academic-sounding terms, "mental model" does not immediately call up a single, clear picture, although a moment's reflection on the words themselves may bring that picture into focus. A model held in the mind. *What is that, exactly?*

Acknowledging that specialists in various disciplines will tend to define the idea of mental models depending on, shall we say, their own mental model of it, still, one working definition of a mental model is a set of thoughts and beliefs that a person holds about how something works—or, more expansively, about how something is. Even more basically, mental models are representations in the mind of real or imagined conditions or situations—*our model of reality.*[2]

When we're communicating, we're constantly negotiating with others' mental models and with our own. For instance, here, one person is describing how the organization they all belong to works.

Like other models, mental models are often simpler than the thing or concept they represent, and thus are often incomplete.

The simplification, incompleteness, and even errors inherent in some mental models play out in our experience as these models help shape our behavior and define our approach to solving problems and carrying out tasks.[3]

Consider, for example, the mundane task of going to a restaurant. Most Americans have a pretty well-developed mental model of this activity. But a person unfamiliar with a buffet-style restaurant may wait a very long time for a waiter if her mental model of "restaurant" only includes being served her food.

From this example it's evident that mental models are informed by that person's experiences, beliefs, and understanding. While, by their nature, such models are held in memory and applied to new information, we are biased toward confirming our existing models and making changes only with some reluctance.[4] So, how *do* they change?

One way to talk about the change is as a kind of learning. In general, learning involves a single feedback from the environment (the "real world") and an adjustment to our previous understanding. Our buffet-style restaurant-goer, for example, will in time observe that no waiter is coming and learn that she needs to get up and serve herself from the buffet line.

However, her learning may extend to some change of the mental model itself, through a "double loop" that alters her mental model.[5] In this case, the learning involves a shift in her concept (model) of a restaurant to include both places where one is served and where one serves oneself (Figure 1, next page).

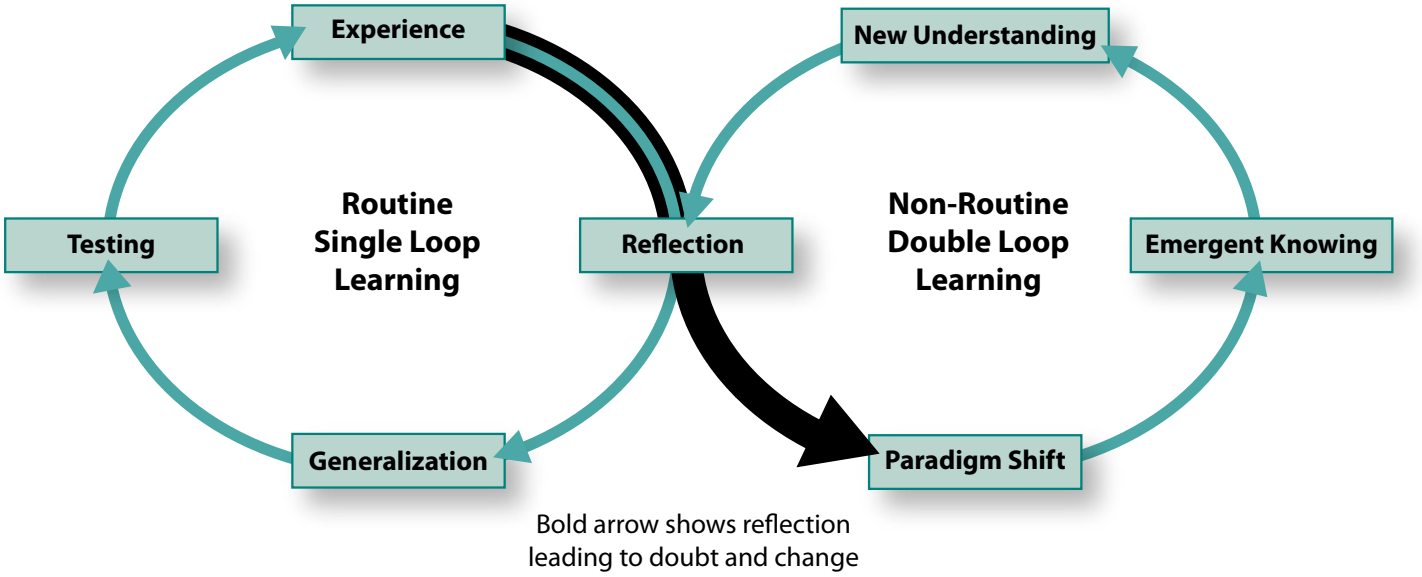


Figure 1.—Single and Double Loop Learning. (Based on Brockbank and McGill 1998.)

How are others' mental models relevant to communication?

Appreciating that others may have different mental models of any substantive topic of discussion is part of the foundation for successful communication. This thought bears reflection. It should not be hard to think of instances in which one's conversation with another drifted about because—though the same or similar words were used—apparently quite different things were understood about the phenomenon that the words referred to. Consider again the example of *going to a restaurant*—or greater complexities such as *preparing for climate change*.

If detecting and understanding mental models of others are keys to communication success, how does this detection and understanding occur? Well, as baseball sage Yogi Berra famously observed, "You can learn a lot just by watching"—and indeed, one learns most about others' models just by listening for them. As with Berra's comment, this observation is actually subtler than it first seems. The real questions are what we're listening for and how we're listening. The answers to these questions are properly the province of mental models interviewing.

Mental models interviewing employs systematic procedures to obtain insights about others' knowledge and perceptions concerning a topic, and is often a component of a larger communication strategy focused on these others and this topic.

Interviewing

What we're listening for

Conversation is a distinctive feature of being human, learned in early childhood. Beyond "casual" conversations that often have no set or explicit purpose, people are very familiar with more structured conversations in which they ask questions of others with varying degrees of purpose and structure.

Interviews are conversations with a planned purpose to gather information, and they are a familiar experience to anyone who has gone through the process of securing a job. Many professionals—journalists, physicians, university Extension personnel—routinely interview others as part of their work, usually adapting an approach and a structure to their line of inquiry and suited to their purposes. Social scientists, in an attempt to gather information in a valid and consistent way, have developed additional norms and structures for interviewing. Starting in the 1950s, survey researchers began to set standards for interviewing involved in such tasks as census, medical, and market research. Such survey research goes beyond simply gathering information from individuals, to being able to validly measure individual differences.

Mental models interviewing (MMI) descends from this social science tradition and also seeks validity in results from methods that are clear and consistent. But MMI is distinct from other interviewing in its focus, of course, on mental models—actually on two sets of models, those held by the subject-matter specialists and those held by the interviewees who are not subject-matter specialists (referred to here, for simplicity rather than completeness, as nonspecialists).

In *Risk Communication: A Mental Models Approach,*[6] decision scientists at Carnegie Mellon University placed such interviewing in the context of successful communication about risk. In order to communicate successfully with nonspecialists about a risk elucidated by scientific or technical knowledge, it's necessary to understand what the nonspecialists know, don't know, and believe about the risk, relative to the understanding that the specialists currently have. Interviewers hope to compare the mental model of the risk held by the nonspecialists with that held by the specialists; and to gain that understanding, interviewers conduct semi-structured interviews with the nonspecialists.

Semi-structured interviewing is a way to elicit qualitative information in a systematic manner. It uses a pre-written set of questions as a starting point, but remains open-ended in that the interviewer gives no hints regarding what topics should be addressed, nor does the interviewer impose constraints on the expressions of the interviewee at the beginning of the interview.[7] Open-ended mental model interviews have their roots in the tradition of cognitive psychology. The method for collecting interviews is based on what is called a think-aloud protocol.[8] This method gives the interviewee freedom of expression through the use of open-ended questions, while also providing structure through the use of pre-written questions.

The knowledge of the nonspecialists' views, particularly their gaps in understanding, misconceptions, and other problems they may have in comprehending or accepting specialist knowledge, permits the development of communications approaches and materials that are well suited to a particular group and addresses these gaps, misconceptions, and other problems.[9]

In practice, mental models interviews follow a "funnel design"[10] that starts broad and becomes narrower, beginning with exploratory questions that permit respondents a fair amount of latitude with what and how they answer, then gradually increasing the structure of the interaction and the focus of the questions to reveal, or at least glimpse, an interviewee's mental model in a reasonable amount of interview time.

The *Risk Communication* authors describe the subtle shifts that occur during the semi-structured MMI process:

> At the beginning, we run the risk of missing important beliefs because respondents' train of thought has drifted off in other directions, or they are unsure about whether an idea would be considered on topic—but we run little risk of putting ideas in their heads. Toward the end, we pick up beliefs that might otherwise have been lost—but we run the risk of suggesting beliefs or inducing their creation. The intermediate stages direct respondents to the major areas of the influence diagram [*a rendition of the specialist model*] in the hopes that bringing up such core [*risk*] topics as exposure, effects, and treatment will correct oversights rather than reveal hitherto unknown topics.[11]

How we're listening

In a broad sense, mental models interviewing is similar to many other conversations in which individuals are trying to detect the model or sense of reality that the other person holds, in order to communicate more successfully (if not immediately, perhaps, then at some future time). One difference in deliberate MMI is in the amount of self-discipline that the interviewer needs to impose on him- or herself.

This self-discipline may feel unnatural to the interviewer in the social situation of an interview, when, for instance, one is tempted to fill a dull silence or "help out" a stumbling response. But the self-discipline is vital for two main reasons—(1) to allow respondents equal opportunity to express their unique mental model, and (2) to abide by the study's strict method so that data from interviews can be effectively analyzed. A primary text on survey research methods explains:

> In all sciences, meaningful measurement occurs by applying the same procedure across a set of situations so that differences in the readings that result can be compared and interpreted as indicating real differences in what is being measured: The same is true for surveys [*interviews*]. In this case, though, the standardized measurement process is asking a question and the "measurement" that comes out of the process is the respondent's answer as recorded by an interviewer.[12]

Study design should take into account, in advance, this need for self-discipline as well as other practical matters.

Conducting the interview: practical considerations

One scholar maintains that the interview is a special interaction with a special set of rules, which the interviewer is responsible for following.[13] Practical matters for showing up for the interview—and even setting up the interview—require some forethought. For example, the interviewer should consider a natural tendency for respondents to be curious about the purpose and use of the interview, the interviewer's position within the organization conducting the research, and—possibly—the interviewer's own views on the subject. In addition, sociable interviewees may want to exchange information, and cautious ones may want to gauge how the encounter may benefit or harm them, making it essential for the interviewer to consider how much information to withhold or provide before engaging an interviewee.

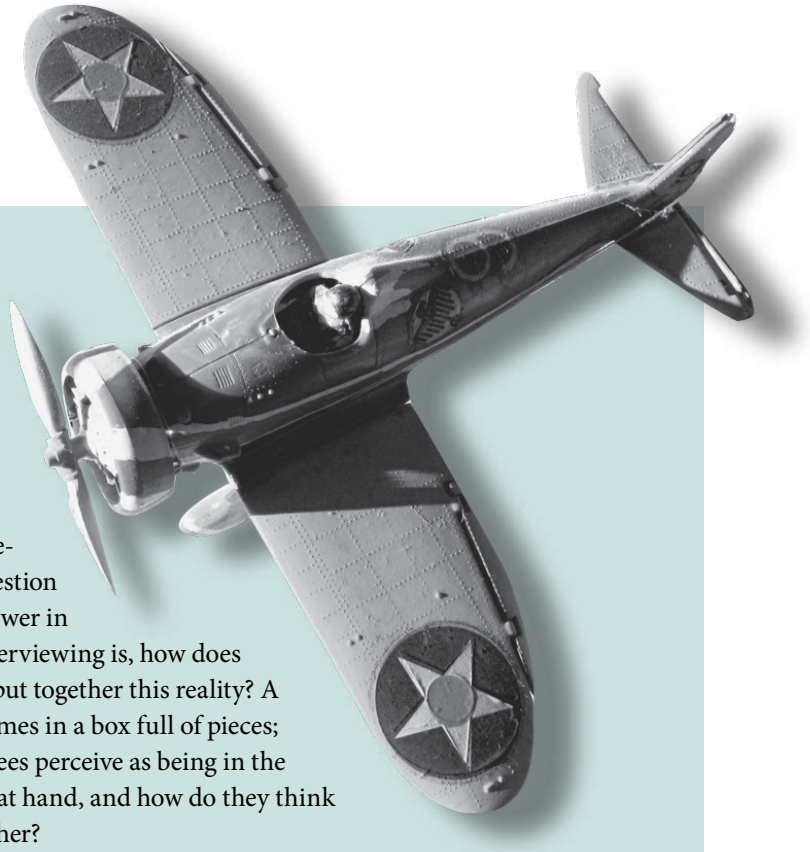
As mentioned earlier, MMI uses a method for collecting specific information and attempts to structure a limited conversation such that only the interviewee's mental model of the topic is exposed. Here are a few guidelines based on one project using MMI:

BEFORE THE INTERVIEW

- The language used to solicit interviewees as well as the conversation leading up to the actual interview set a tone. Refrain from giving too much information about the project, but maintain a hospitable presence. For example, a subtle difference in the language of an e-mail or letter of consent may set the tone for the entire

encounter. Consider the difference between asking someone to have a conversation about "climate" versus "climate change." The latter is commonly viewed as a variant of "global warming," which generates considerable disagreement; the former term is much less politically charged.

- If you are unfamiliar with the community or the individuals to be interviewed, ask those who are familiar with the setting how to dress for the interview. Dressing too casually or too formally might be distracting.
- Moving quickly and casually through greeting the interviewee, getting the letter of consent (required for academic studies with human subjects) signed, and setting up the recording device are very important. Having a well-rehearsed script and considering what questions and concerns the interviewee might ask increase the ease of the session. For example, the interviewee may be concerned about confidentiality or how long the interview might take. It's important to anticipate these concerns, determine how much time they'll take to address, and decide how to address them.
- Don't neglect material considerations such as having backup batteries or a plug-in for your recording device, a pen for signing the consent forms, and a quiet place to interview; these details are all essential to getting the information you want.



Models

Just as a model airplane is a representation of a real airplane, so are mental models representations in our minds of something real. The question we're trying to answer in mental models interviewing is, how does this other person put together this reality? A model airplane comes in a box full of pieces; what do interviewees perceive as being in the "box" of the topic at hand, and how do they think the pieces fit together?

More precisely, interviewers often want to know how interviewees understand causes and effects. For example, if people understand that climate change is said to be caused by a buildup of heat in the atmosphere, and their model of the atmosphere includes the idea of a hole in the ozone, they may wonder why the heat doesn't just escape through the hole—and so, how could there be a climate change problem?[15]

DURING THE INTERVIEW

- Particularly if your relationship with interviewees will continue beyond the first session, keep interviewees focused on the big issue, refraining from straying into too many personal exchanges of opinions that might color the interview or future encounters with the interviewee. "Cordial, nonjudgmental" is the way to go.[14] A "hands-off" style, which may not feel natural, helps build neutrality and rapport.
- In order to keep track of questions and responses, the interviewer should have the approved questions printed and a tally sheet prepared for each interviewee. An example of mental model interview questions is included in the Appendix.

Potential Pitfalls	Description	Possible Solutions
Deference Effect	People will tell you what they think you want to hear.	Being non-specific (but still honest and conversational) about your position might be necessary. Many people automatically make stereotypes based on factors such as clothing and job title, so forethought about how to maintain neutrality is essential. Starting with very general questions can help avoid this pitfall.
Third-Party-Present Effect	If there is a third party present in the room, an interviewee might modify answers based on that third party. For example, during interviews with teachers on climate change, students and teachers who come into and out of the room potentially color the answers by the teacher—especially since teachers often try to maintain neutrality in front of their students.	Planning ahead for the right time and place goes a long way toward preventing this pitfall.
Threatening Questions	While many people feel that discussing even a controversial issue such as climate change would not pose a threat, the language used to frame the question might affect the willingness of an interviewee to be candid and open. For example, launching into the political aspects of an issue might be more threatening than just discussing observable environmental effects.	Because a topic such as climate change might be politically charged in the community, questions should explore the topic in a general way at first. Questions should be worded in such a way that, if scientific understanding is to be gauged, political language is avoided. Follow-up questions about barriers and values might explore politically charged topics; also, the interviewee may automatically start talking about more charged topics just by answering a general question.
Expectancy Effect (Rosenthal and Rubin 1978)	Our expectations as interviewers might shape the outcome of the interview. This is different from distortion, which means seeing what you want to see. Rather, the expectancy effect describes how your behavior can affect the behavior of the interviewee.	This pitfall requires being intentional about your relationship with the interviewee. Specifically, it is essential to maintain a type of neutrality, especially in the follow-up questions during the interview, which will be explored later in this text. Key: we don't want to create the "objective" results we expect to see; we want to map the interviewee's understanding of the study topic.

Figure 2.—Potential Pitfalls. (Adapted from Bernard 2000.)

- In addition to recording and following a script of questions, continue paying close attention during the interview. It is essential to be listening for possible leads or key statements to further explore with follow-up questions (see Figure 3 for examples of ways to probe). This process can be mentally tiring. Until you know your own limits, schedule no more than three or four interviews a day.
- During the interview, expect to (gracefully) interrupt the interviewee to stay on task.
- If the interviewee appears to be getting fatigued, bored, or anxious about time, telling him or her how much longer it will be might be all that is needed to continue getting high-quality, detailed responses.

While asking the questions, a few common pitfalls might occur. See Figure 2 for a description and some possible solutions.

- If the interviewee misunderstands the question, start by repeating the question, and shortening its parts by pausing or reading more slowly. Including a predetermined follow-up question from your script might also help. Caution, though, should be practiced in introducing new terms or connections between concepts that the interviewee might not have as part of his or her mental model. Many outreach professionals define terms, rephrase statements, or pose questions in a way that might better communicate, inform, or educate, but try to not do this during the interview. For example, if the interviewee misunderstands a question like "What associations do you have with the term 'global warming,'" refrain from defining global warming. It would be appropriate, however, to define or clarify what you mean by the term "associations."

Of course, it's also possible that the interviewee's hesitation over a question may be due to poor wording of a question. Alas, reviewing and changing questions should be done during the planning stages *before* the interviews occur, rather than in the midst of the interview.[16]

AT THE END OF THE INTERVIEW

- Often the interview will end, you will turn off the recorder, and the interviewee will continue speaking, sometimes presenting very valuable material. If the material is pertinent to the study, you will want to capture it, so either ask the interviewee if it's OK to turn the recorder back on, or simply do so in full sight of the interviewee, making eye contact to suggest that you're doing this with tacit approval. Alternatively, you might simply choose to leave the recorder on until you and the interviewee have parted.

AFTER THE INTERVIEW

Although you will have some strong impressions and useful insights after completing a number of interviews, you have not completed the MMI process. The raw material from interviews must be coded and analyzed, and then checked and confirmed, typically through a questionnaire.

The analysis or confirmation stages are described in more detail in *Risk Communication*.[17] However, one short timesaving tip is worth mentioning here: it is advisable to have an experienced person transcribe the audio recordings of the interviews. Beyond rapid keyboarding skills, a professional transcriptionist will have the appropriate hardware and software to produce a text file ready for coding and analysis—usually far more quickly than one could do it oneself.

Interviewer Technique	Description	Application in Mental Models Method	Example
Silent Probe	At the beginning, informants might be looking for guidance as to whether they are on the right track. Silently wait as the interviewee thinks about what to say on the subject.	The beginning of the mental model interview should be very general; no hints or constraints should be imposed. While somewhat uncomfortable at first, this method allows for interviewee to begin "dumping" thoughts and beliefs and understanding about subject.	If an interviewee pauses for any reason, refrain from jumping in with comments or interrupting what might be a silent moment of reflection.
Echo Probe and the "Uh-huh" Probe	An interviewee is speaking and you wish to be conversational without injecting your thoughts or new vocabulary. This probe is useful when someone is describing a process or event; simply repeat what the person has just said or reply with "uh-huhs."	Because the MMI requires the interviewer to remain neutral, this probe works. It is conversational in the sense that the interviewer is interacting; however, nothing new has been introduced into the conversation.	The interviewee mentions flooding in 2007 and 2008. You might say, "I see. There were floods here in both 2007 and 2008." (Unspoken: "Go on!")
Tell-Me-More Probe	This is a most common probe, in which the interviewer basically asks to hear more about a certain topic.	While the previous probes were useful in getting out of the way of the interviewee, this technique identifies a "rabbit hole" to chase down for more information. For the sake of staying on-topic and getting what is needed in an efficient way, it's best not to overuse this technique.	You might say, "Earlier, you mentioned that folks in rural areas are suspicious of climate-change science; can you tell me more about that?" A different, more-specific version: "Why, exactly, do you feel that way?"
Long Question Probe	Sometimes a longer question can induce a longer, continuous response.	Proceed with caution during the MMI—this probe should be decided and written as part of the script before the interview begins for the sake of consistency.	If an interviewee is struggling to be descriptive, combining the original question with a few of the potential follow-ups that are written to get more detail could induce a longer response.

Figure 3.—Interviewer Techniques. (Adapted from Bernard 2000.)

Appendix

The worksheet used for recent MMIs is reproduced below. Note that the interview protocol, the informed consent process, and the questions required prior approval by our university's Institutional Review Board (IRB). Researchers should be sure to comply with their own institution's rules.

———

Informed-consent process: verbal preview

Before we begin, I need you to understand and consent to the interview. The interview format has been approved by Oregon State University, and this form [hand it to interviewee] lets you know that this interview poses no risk to you; all of your responses will be anonymous and confidential; and the recording we'll make will only be listened to by the research team. Also, you have the right to end the interview at any point, although it will really help us most if we're able to complete the interview. It should take about a half-hour.

Goals for county study: Purpose is to understand the mental models of (a) climate-related risk and (b) effective responses to those risks that these leaders perceive.

Outline of questions

Reminder note for interviewer: At the beginning it's important to conduct the interview in an open-ended way, following and clarifying as needed what the interviewees offer. We're trying to elicit their views, and each of the first three questions should be allowed to stretch out to capture what's on their minds.

INTERVIEWER:

- In this project, we're trying to find out what's on coastal residents' minds relating to the climate. There aren't "right" or "wrong" answers, we're really just interested in knowing what you think. So to get us started, please tell me what comes to your mind about the Oregon coast and climate.
- What associations do you have with the topic of "global warming"?
- What associations do you have with the topic of "climate change"?

  Clarifying question: What comes to mind as you consider these terms?

MORE-SPECIFIC QUESTIONS: FUNNELING DOWN TO FINER DETAILS

I am going to ask you some more specific questions. Some of them may seem to repeat things that you have already said. Please bear with me; I need to ask all of the questions to make sure I have covered everything. If you feel you have already answered a question and you have nothing more to say on the topic, feel free to refer to a previous answer.

- What are some major climate-related events you have seen in the county?
- How were these climate-related events dealt with or managed?

Follow-up if warranted: How effective was the response to the climate-related event?

- How is the coastal climate in the county changing?
- How might the coastal climate here change in the near future?
- What are the possible effects of the changing climate in the county? Which effects are you most concerned about? Do you think about risks that might be associated with those effects?

Follow-up: Do you think there are risks associated with changes in [all of the following that respondent does not address in previous question] ocean temperature…rainfall…coastal storms, winter wave heights, and ocean chemistry?

- Have you heard how other coastal community leaders anywhere in the country or in Oregon are dealing with the potential effects of climate-related risks?
- What actions do you think should be taken for dealing with climate-related risks in the county?
- What sort of priority do you place on dealing with such risks?
- What distinction do you make between long-term and short-term planning for climate-related risks?
- What problems do you see, if any, with your community addressing the climate-related risks you've been talking about?

PHOTO ASSOCIATION QUESTION

- I'd like to show you some pictures. Please describe what you see as you would to a friend.

  (Show images of greenhouse effect, ozone hole, coastal winter storms, snowpack, landslides, surf runup, house on bluff, water glass, recreational ocean fishing, sunny day. Visuals may remind interviewees of details they have omitted, though they need not feel compelled to respond.)

WRAP-UP QUESTIONS

- What is your role in the community?
- How long have you lived there?
- What is (or was) your profession/work?
- Who are other community members you would recommend we talk with about climate-related risks and issues?

Thank you very much for participating.

Endnotes

1 While this article reflects a collaboration, authorship responsibilities have been split: Winters' begins with "Conducting the interview."

2 For a thorough review of the history of mental models, see Johnson-Laird, P. N. (2004), "The History of Mental Models," *Psychology of Reasoning: Theoretical and Historical Perspectives*, K. Manktelow and M. C. Chung, New York, Psychology Press: 179–212.

3 Craik, K. 1943. *The Nature of Explanation*. Cambridge: 61.

4 http://en.wikipedia.org/wiki/Confirmation_bias

A particularly detailed entry in Wikipedia conveys the long history of recognition of this phenomenon, including by such observers as Sir Francis Bacon, who wrote in the 1620 *Novum Organum*: "The human understanding when it has once adopted an opinion… draws all things else to support and agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects or despises, or else by some distinction sets aside or rejects."

5 For a useful treatment of mental models and loop learning, see Sterman, John D., "Learning from Evidence in a Complex World," *American Journal of Public Health* 96, no. 3 (2006): 505–14.

6 Morgan 2002.

7 Morgan 2002: 24.

8 Morgan et al. refer here to Ericsson, A., and H. A. Simon (1994), *Protocol Analysis*, 2nd edition, MIT Press, Cambridge, Mass.

9 Downs, Julie S., Pamela J. Murray, et al. (2004), "Interactive Video Behavioral Intervention to Reduce Adolescent Females' STD Risk: A Randomized Controlled Trial." *Social Science & Medicine* 59(8): 1561–1572.

10 Morgan 2002: 64.

11 Ibid: 64–65.

12 Fowler, 1990: 14.

13 Ibid: 50.

14 Bernard 2000: 226.

15 Leiserowitz, A. 2007. "Communicating the Risks of Global Warming: American risk perceptions, affective images and interpretive communities." In S. C. Moser and L. Dilling (Eds.), *Creating a climate for change: Communicating climate change and facilitating social change* (pp. 44–63).

16 Bernard 2000: 20.

17 Discussed in parts of chapters 4 and most of 5 in Morgan 2002.

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